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ABSTRACT

Presented is a description of a new design for longitudinal comprehensive achievement monitoring. There are several components of this design which distinguish it from the usual classroom achievement testing programs - (1) a model of school learning to direct the choice of variables to measure, (2) a comprehensive set of course objectives defined in behavioral terms, (3) a longitudinal scheduling of testing, and (4) a complete system to process data and report results to the teacher and individual students. (RP)

Project **C**omprehensive
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A NEW DESIGN FOR EVALUATION IN MATHEMATICS EDUCATION: LONGITUDINAL COMPREHENSIVE ACHIEVEMENT MONITORING

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(Paper presented to the Research Reporting Sections of the annual meeting of the National Council of Teachers of Mathematics, April, 1969.)

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A New Design for Evaluation in Mathematics Education: Longitudinal Comprehensive Achievement Monitoring

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The authors will describe a new design for longitudinal comprehensive achievement monitoring. The design has been developed under the sponsorship of a four-year grant from the Charles F. Kettering Foundation. It has been operating in five high school mathematics courses for almost two years. The components of the design which distinguish it from the usual classroom achievement testing are: (a) a model of school learning to direct the choice of variables to measure, (b) a comprehensive set of course objectives defined in behavioral terms, (c) a longitudinal scheduling of testing, and (d) a complete system to process data and report results to the teacher and individual students. The usual classroom achievement testing does not have a model of school learning, schedules tests for immediately after instructional treatment, uses a narrow set of generally poorly defined objectives and makes only a crude analysis of results.

The model. Several recent researchers have attempted to model school learning. A semi-quantitative model (Carroll, 1967) appears particularly useful as a starting point in choosing variables to measure and adequately describe school learning, but should be expanded.

Our model incorporates student and instructional variables. First, our model includes a measure of student motivation rather than of perseverance, which Carroll uses. Second, although a student may be motivated to perform a particular task, his anxiety at entering the tast situation or being evaluated may interfere with several of the skills which are necessary for performing the task. The effect of anxiety on complex learning has been investigated by Spielberger and will be included in our

model. Third, sociological variables are included and appear particularly important in public schools which enroll students from a broad range of family backgrounds. Fourth, the variables of rate of learning and initial achievement correlate very highly with achievement output, but have been found in preliminary studies to be independent of one another. Finally, the instructional variables include measures of the teachers, treatment characteristics, and time.

Comprehensive objectives. It has only been in recent years that teachers have begun to define their objectives in behavioral terms. Authors like Mager have written persuasively in favor of specifying instructional objectives in terms of observable student behaviors. The teacher is expected to define the objectives of his entire course before it begins in terms of observable student behavior by composing questions which measure acceptable levels of student performance for the objectives he set for his course.

Longitudinal testing schedule. The third distinguishing aspect of the comprehensive achievement monitoring is the longitudinal consideration of students' achievement on each course objective. In usual classroom testing a test of achievement is given immediately after an objective or set of objectives has been presented by the teacher. The test usually includes items which measure only the objectives taught since the last testing. Therefore, the teacher has available estimates of student achievement only on the objectives he has just taught. The usual situation contrasts with that of comprehensive achievement monitoring where an estimate of student achievement on each of the objectives is available at each testing period. Therefore, teachers can make statements about a student's pre-instruction, post-instruction, and retention of material as well as rate of learning. For example, if objectives one through ten are taught consecutively, and achievement is monitored after each is taught, then at time four, just after objective four has been taught, the estimate of student achievement on objective four is an immediate post-treatment achievement. The estimates made at the same

time for objectives one through three are retention measures and those of objectives five through ten are pre-instruction measures.

The system. The system for achievement monitoring includes the parts (a) model of the parameters, (b) focus of the evaluation, (c) resources for the evaluation, (d) collection of the data, (e) organization of the data, (f) analysis of the data, and (g) report of the analysis. Computer programs have been developed to handle the large tasks of analysis and reporting results. Other components of the system have been designed to operate at several levels, i.e., both with or without the computer.

Implications. The new design for evaluation in mathematics education provides longitudinal, comprehensive information on the achievement of individual students and groups of students on the performance objectives of the course. It is able to provide information on achievement on a standard scale for the course across time (a) before instruction, (b) immediately after instruction, and (c) a long time after instruction.

The data collected by the system could be used in several ways. First, course improvements could be made based upon the model of school learning. High entry achievement, low post-instruction achievement, or forgetting by the students in a course would each justify modifications in the course. Second, individual student school learning patterns could be plotted and decreases, plateaus or sharp rises in achievement would suggest different activities for the students. Finally, if alternate instructional treatments were administered, each to part of the class, the achievement patterns of the parts would display any differences in achievement between them immediately after or several weeks after the treatment. Therefore the system could be used in empirical research in teaching.